

AOS: Measurements of Aerosol Optical and Cloud-forming Properties

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Aerosol Observing Systems

In-situ surface measurements of aerosol optical, chemical, size, hygroscopic and cloud-forming properties

- SGP

- ARM central facility Lamont, OK

- AMF

- Pt Reyes, CA 3/2005 - 9/2005
 - Niamey, Niger 12/2005-1/2007
 - Murg Valley, Germany 4/2007 -1/2008
 - Shouxian China 5/2008 - 12/2008
 - Graciosa Island, Azores 4/2009

- BRW/NSA

- Barrow Alaska

- AMF2 ? Darwin?

- What instruments support the science?

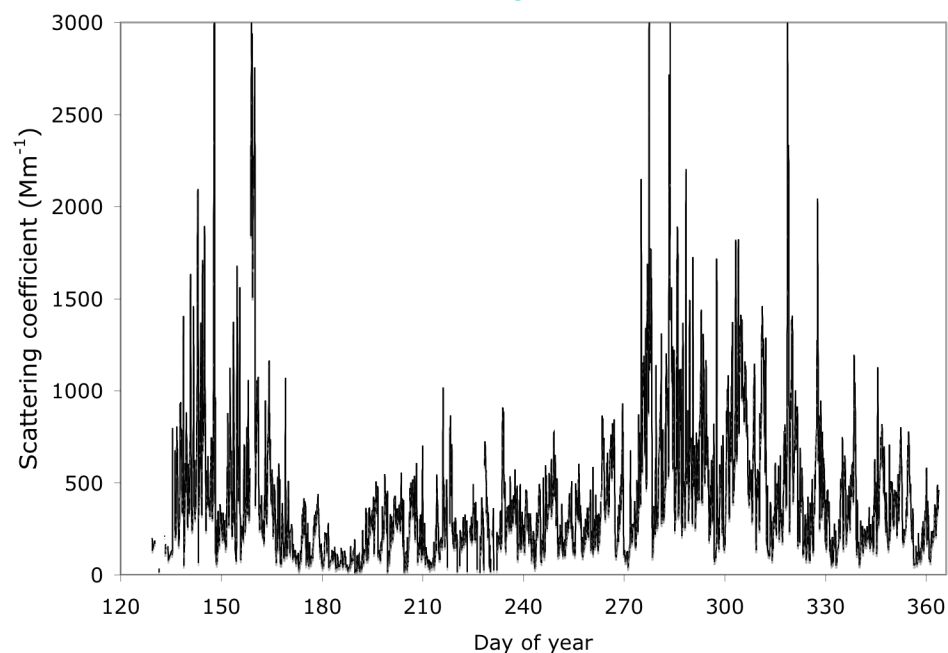
AMF deployment in Shouxian China, HFE



HFE was located at a rural, agricultural area
~120 km from Hefei, ~200 km from Nanking
and ~600 km from Shanghai

Month 2008	Days Rain	Days Fog
May	11	3
June	14	3
July	19	1
August	17	3
Sept	6	0
Oct	10	5
Nov	4	11
Dec	3	6

Sub 10 μm scattering coefficient at 550 nm



Average aerosol optical parameters (green are SGP)

parameter	Ave (std)
Sc (550nm)	410 (395) 40 (32)
SSA (550 nm)	0.89 (0.05) 0.92 (0.04)
Ang (450/700)	1.30 (0.27) 1.83 (0.43)
fRH (550 nm)	1.65 (0.24) 1.70 (0.40)
CCN/CN 0.55% SS	0.53 (0.15) 0.42 (0.18)

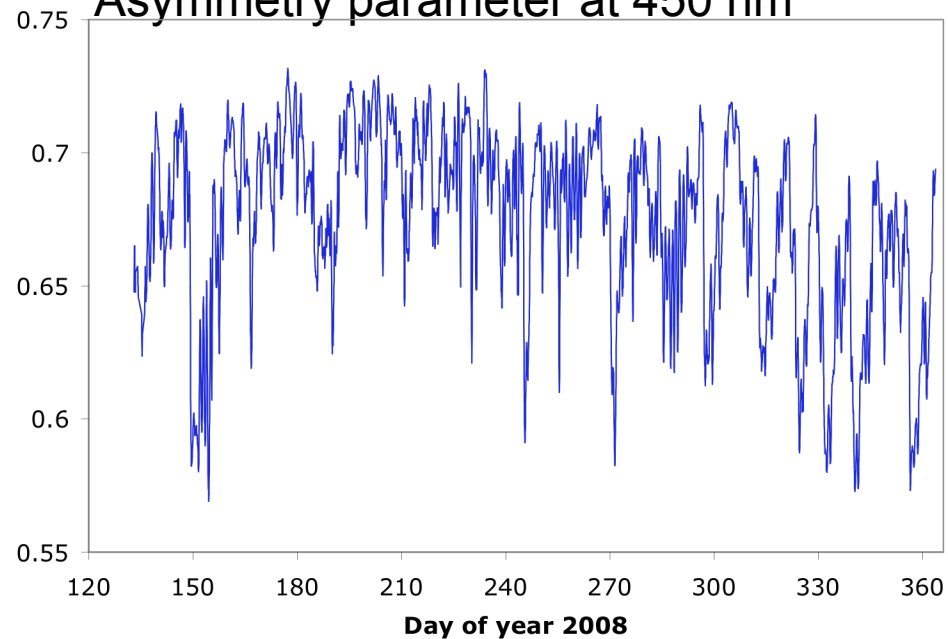
Wheat harvest on day 151

high loading and small, dark aerosol

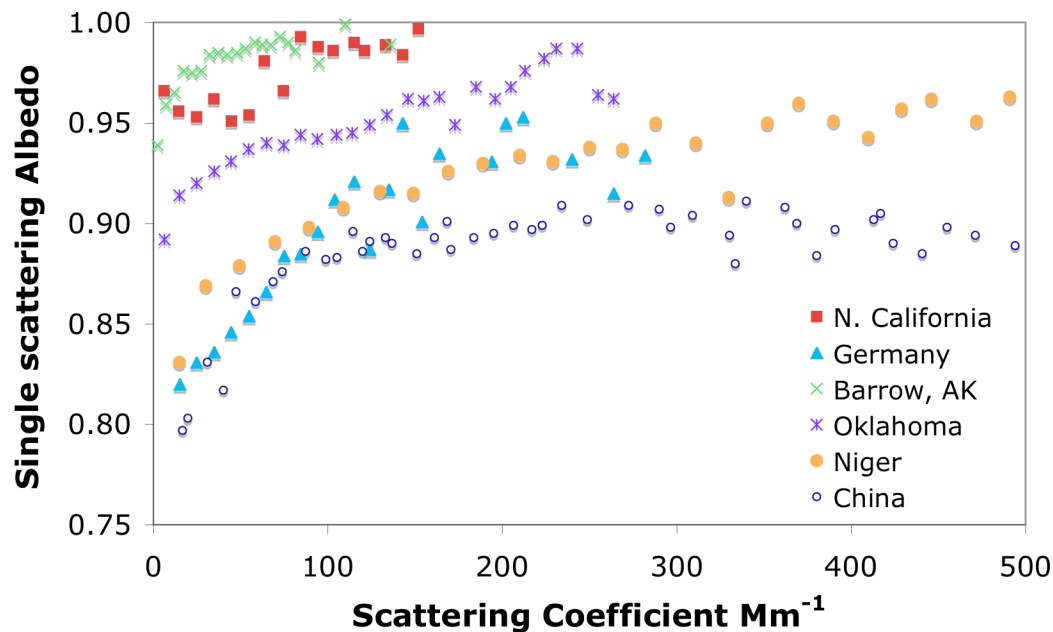
Tech reported crop burning

Aerosol properties vary with rain and fog

Asymmetry parameter at 450 nm

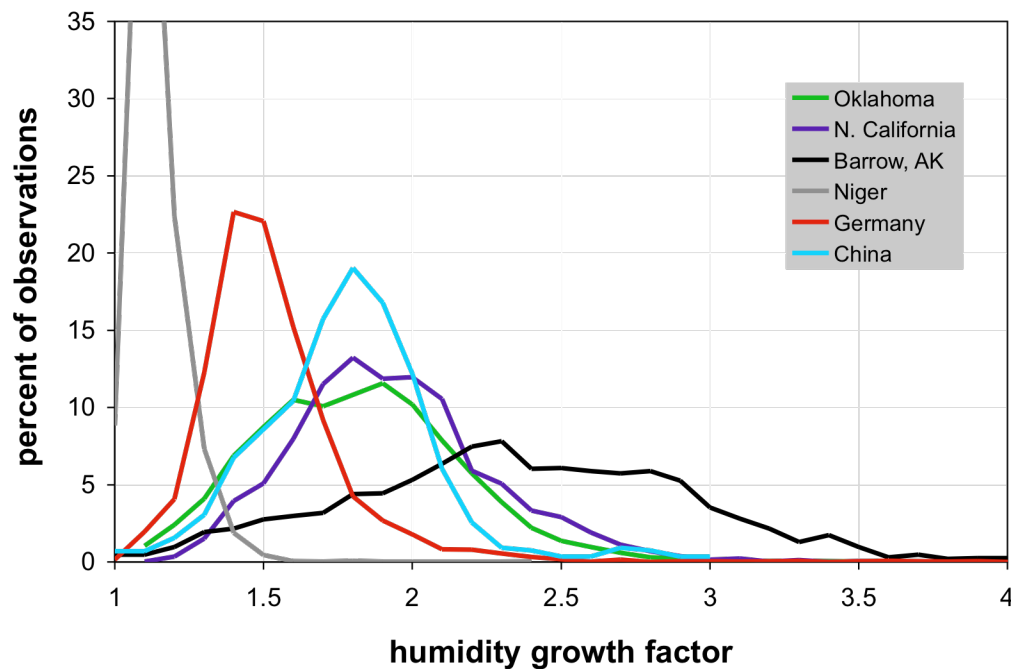


Trends in Aerosol Optical Properties



Variation in the single scattering albedo at 550 nm with aerosol loading at the ARM sites

General trend at most all sites that SSA increases with aerosol loading



Frequency distribution of hygroscopic growth factors at the ARM sites

Temporarily suspend NSA measurements to redesign system to look at upper portion of hysteresis using a dehumidification rather than humidification

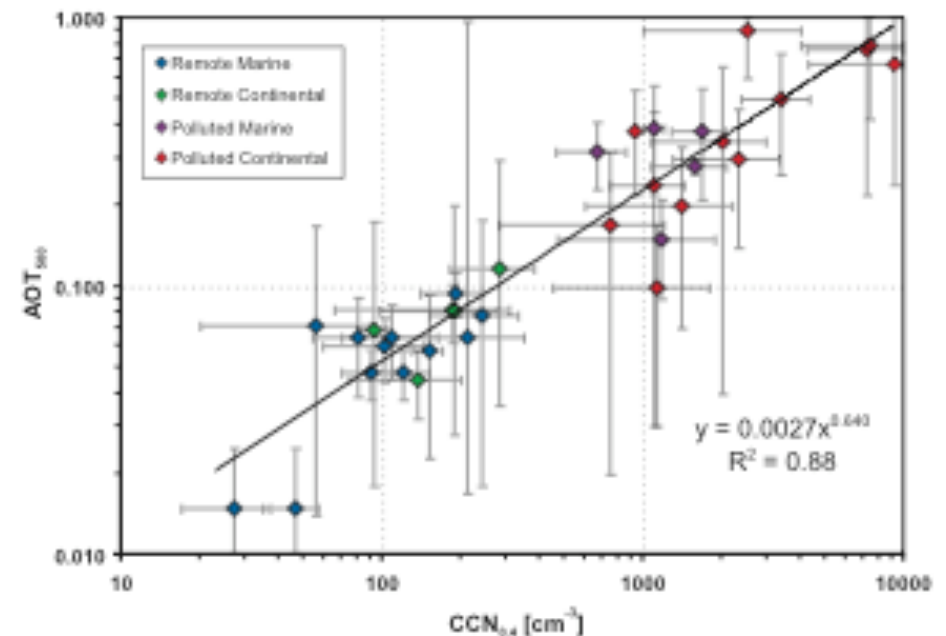
Aerosol-Cloud Interactions (ACI)

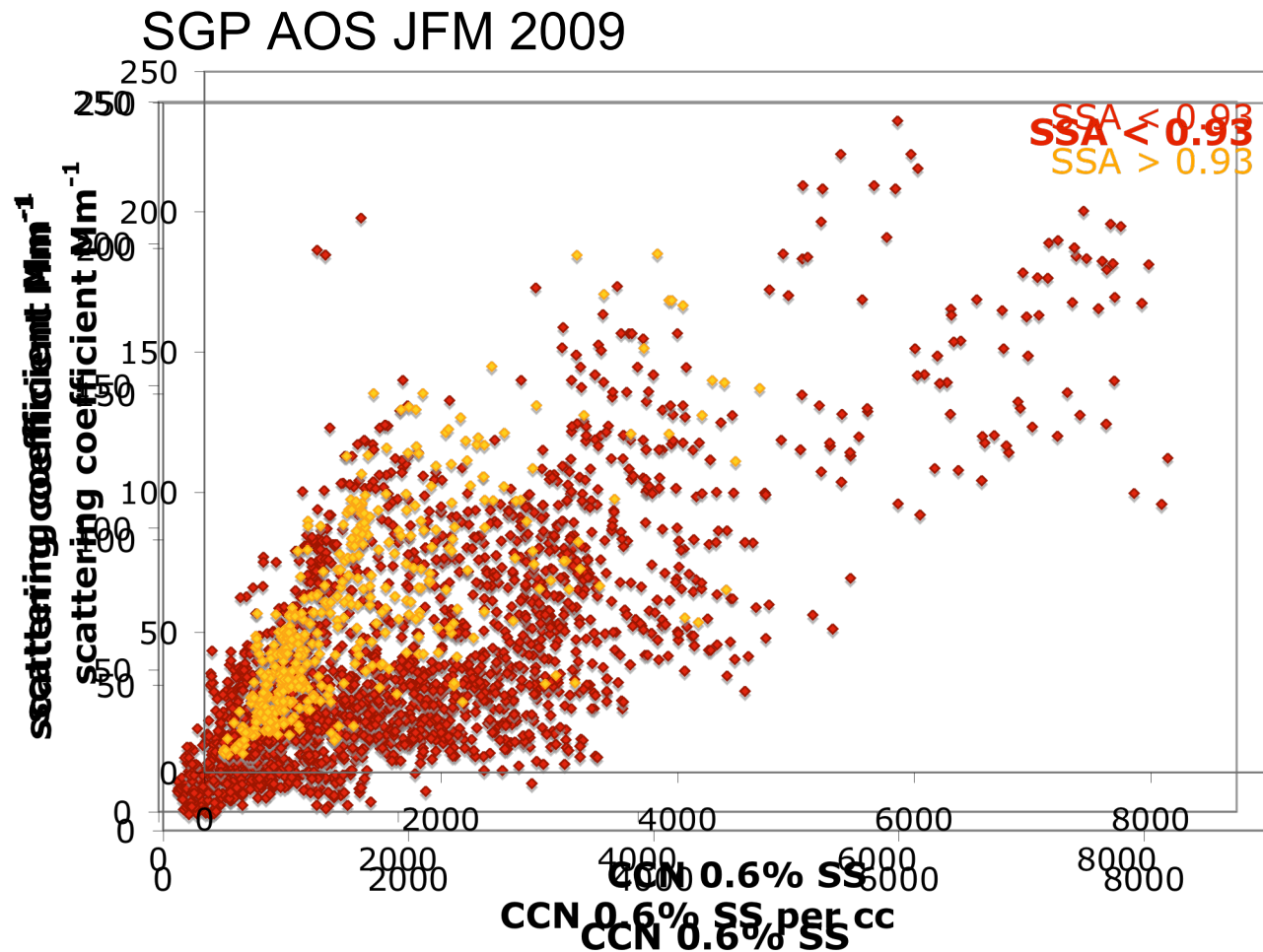
Can we develop semi-empirical methods for quantifying ACI from a limited set of measurements?

McComiskey, A., G. Feingold, A. S. Frisch, D. D. Turner, M. A. Miller, J. C. Chiu, Q. Min, and J. A. Ogren (2009), An assessment of aerosol-cloud interactions in marine stratus clouds based on surface remote sensing, *JGR*, in press.

M. O. Andreae, Correlation between cloud condensation nuclei concentration and aerosol optical thickness in remote and polluted regions, *Atmos. Chem. Phys. Discuss.*, 8, 11293, 2008.

Look at relationship between AOS in-situ optical properties and CCN as a function of % SS to develop an empirical ACI relationship



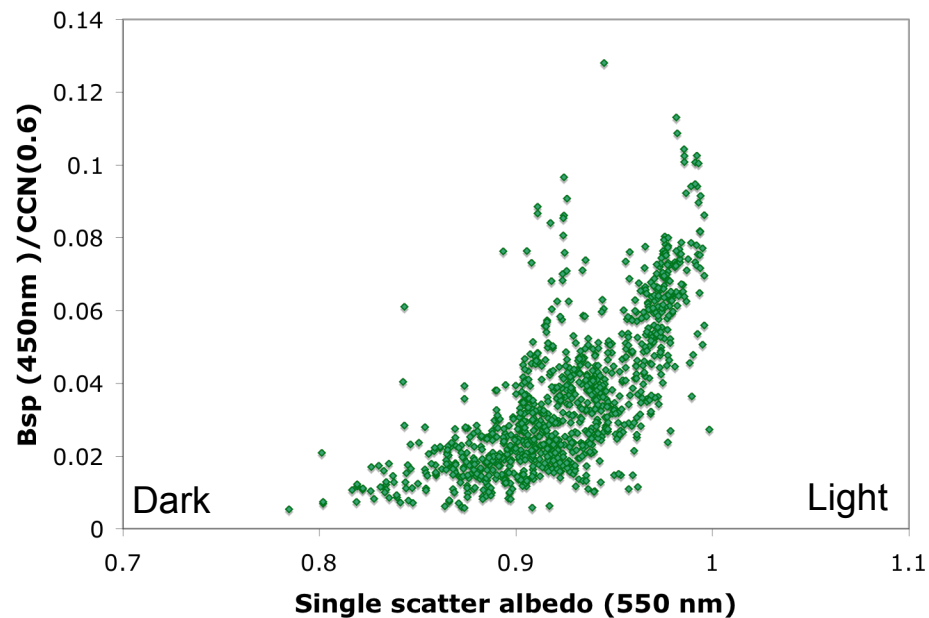


Start with a limited time frame and one site to build ACI model

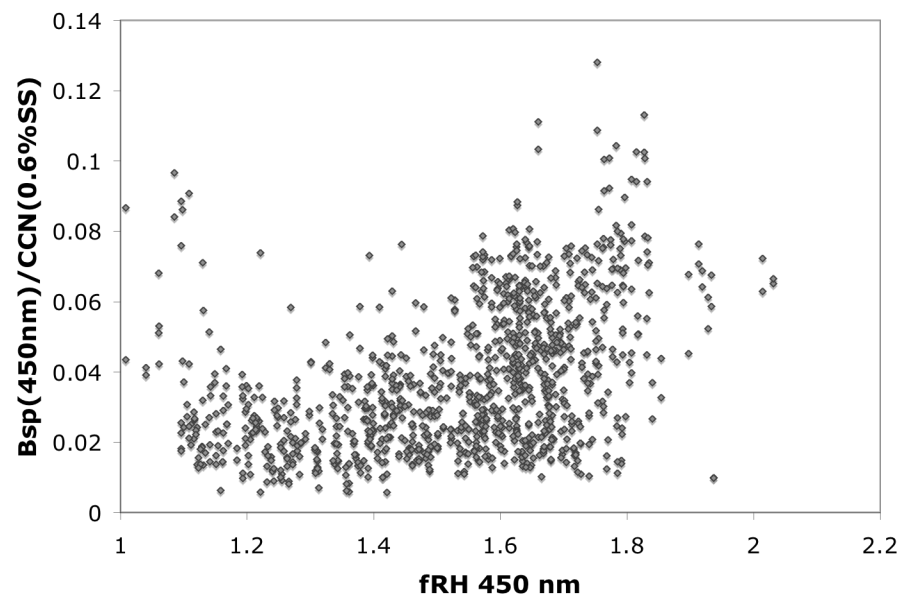
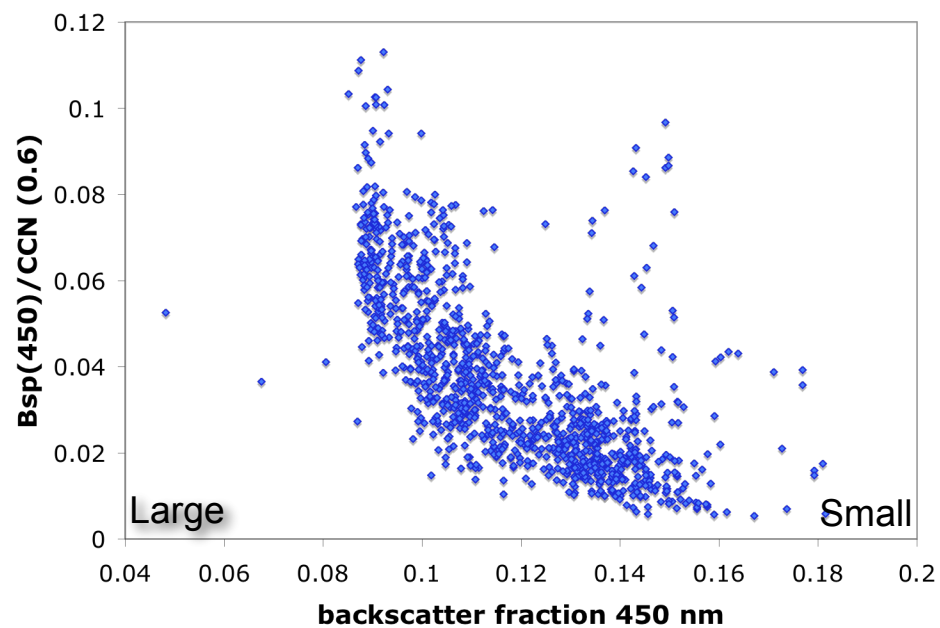
Test predictive capability: $\sigma_{sp}(\omega, \beta, f(\text{RH}), \text{\AA ng}) \Rightarrow \text{CCN}(\% \text{ss})$

Expand to longer time frame and all AOS sites

Add to cloud models



Variability of scattering:CCN at SGP to other aerosol optical properties is indicative of a high concentration of small particles. Other sites and aerosol types may display different trends and behavior.



The Plan

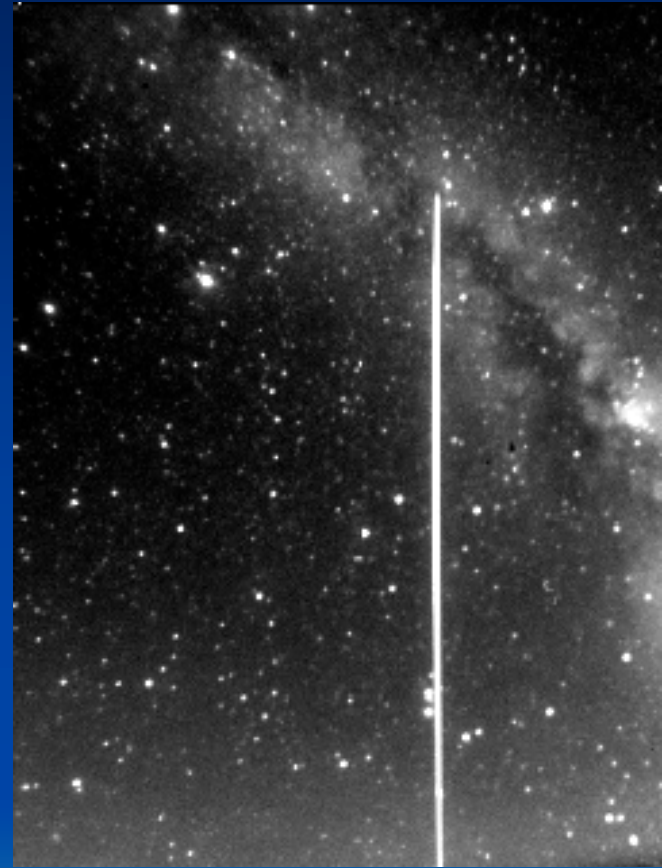
- Get feedback on feasibility and computational methods
- Build ACI model from single site with in-situ data
- Test model ability to predict CCN
- Combine with remote sensing ACI developed by McComisky et al. and insert into cloud models
- Somehow receive funding and find time to do it all

Coastal Aerosol Profiling with a Camera Lidar (CLidar) and Nephelometer

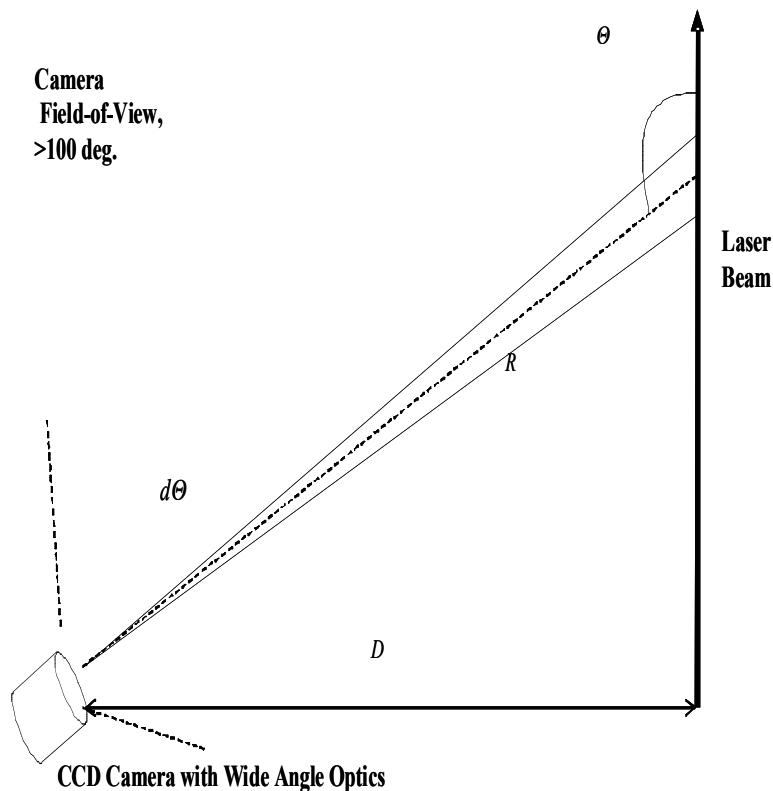
John Barnes, Trevor Kaplan,
NOAA/Earth System Research
Lab/Mauna Loa Observatory

N. C. Sharma, Central Connecticut
State University

Antony Clarke, John Porter,
University of Hawaii



CLidar Technique



Difference between CLidar and Lidar

Advantages:

CLidar profile extends to ground, no overlap function.

High altitude resolution in boundary layer.

Relatively inexpensive, \$12k for camera, lens, laser (cost for housing?).

Disadvantages:

Nighttime (dark) conditions only.

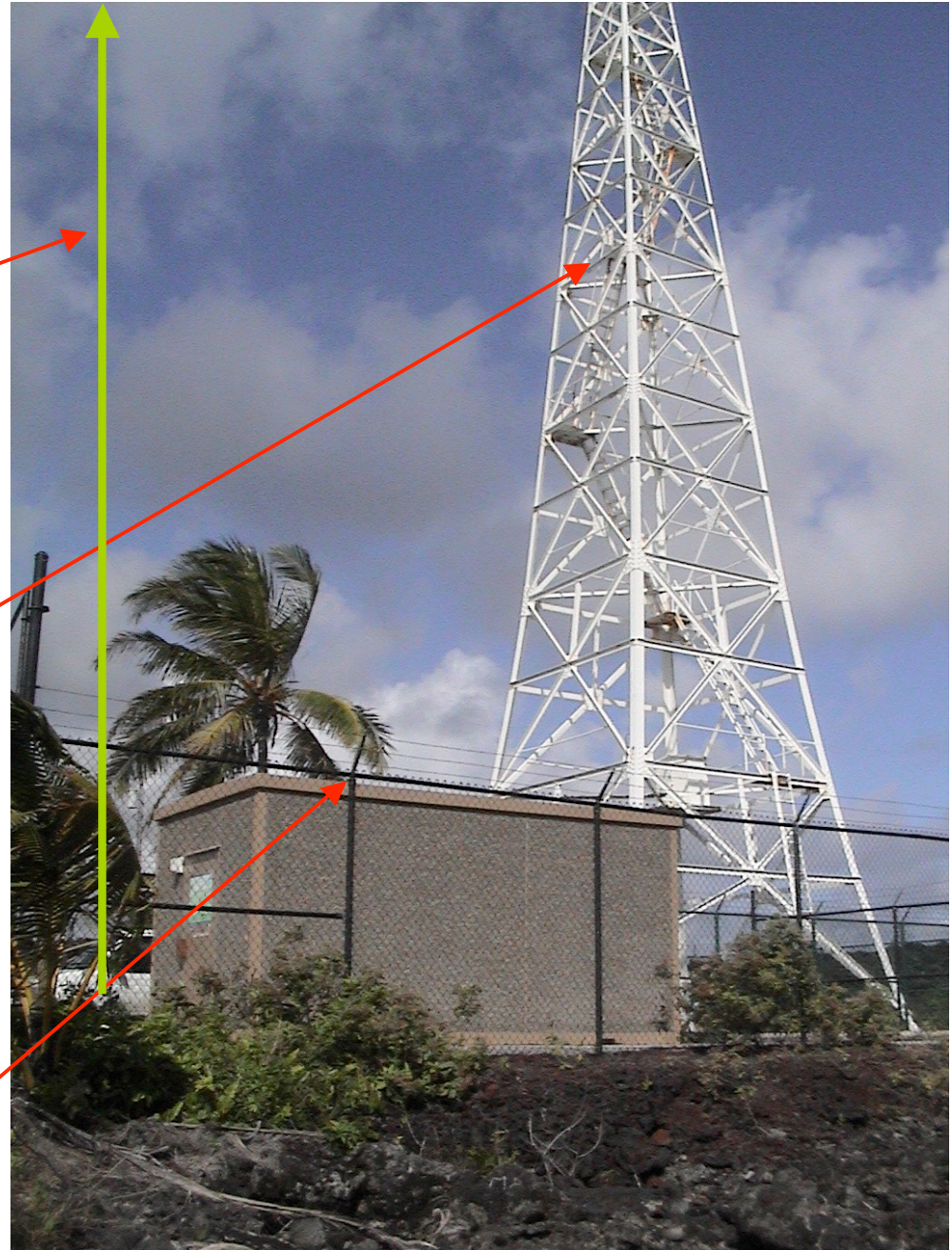
Poor altitude resolution in upper troposphere.

Lighthouse Tower

Laser for CLidar
Camera, Camera is
122 meter West

25 meter intake for
Nephelometer,
Tony Clarke (U of
Hawaii)

Nephelometer on
roof (7 meter)

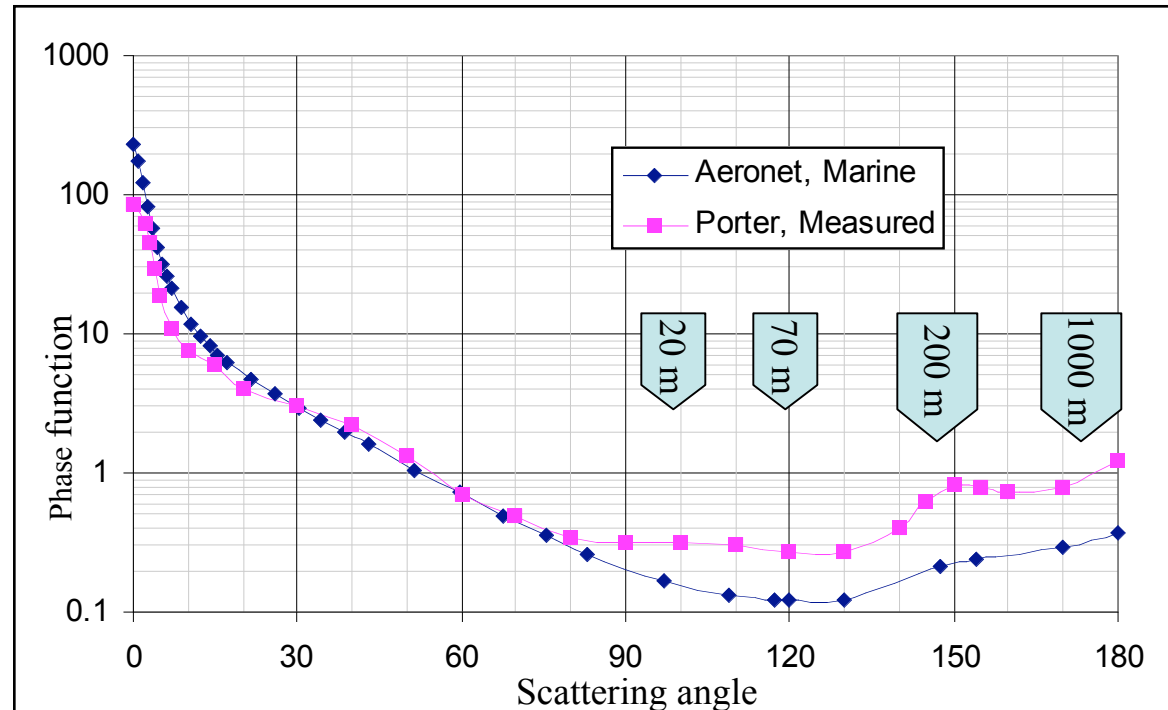


Lidar uses 180° phase function value to convert single-angle scatter to total scatter (Mm^{-1})

CLidar uses 90° value at surface and quickly approaches the same 180° Lidar value as altitude increases (green arrows**).**

Aeronet aerosol phase function is inverted from sun photometer measurements and is a long-term average; represents total aerosol column.

Porter used Polar Nephelometer to measure phase fxn at different time and locations in marine BL

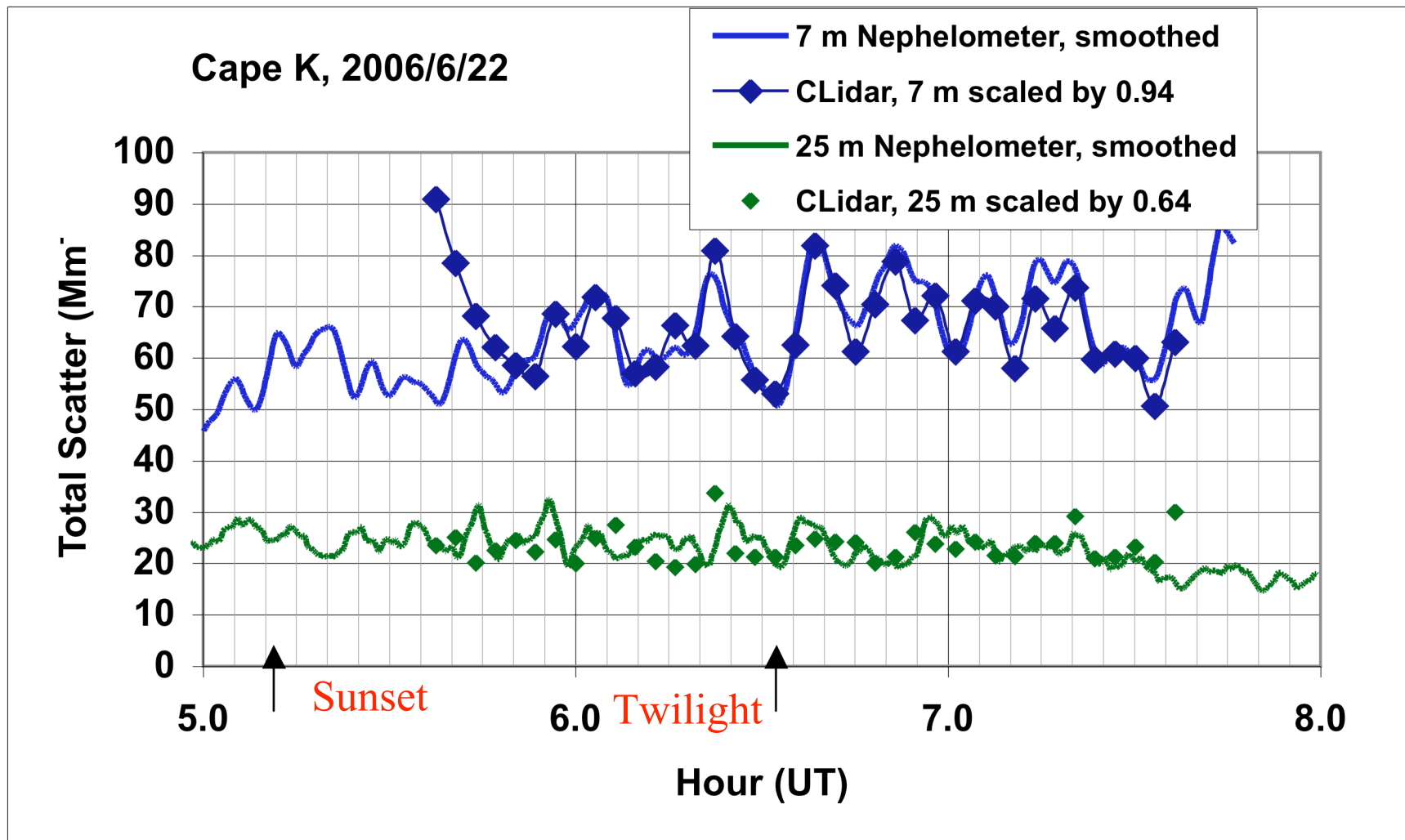


	Asymm. Parameter, g	Hemispheric Backscatter fraction, b	Extinction to 180 deg Backscatter Ratio (sr)	Extinction to 90 deg Side Scatter (sr)
Aeronet	0.71	0.082	33.7	60.7
Porter	0.51	0.198	10.4	39.6

CLidar can track a surface nephelometer.

At 7 m the Porter phase function is a good representation of marine sea salt aerosol (0.94 scaling)

At 25 m the aerosol has larger boundary layer component and Porter isn't as representative (0.64 scale)



Two hours of CLidar profiles (3 minute integration) at Cape Kumukahi.

Cloud base altitude fairly constant (700-800 m).

John Porter's measured aerosol phase function used to convert single-angle scatter to total scatter (Mm^{-1})

